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SCHEME OF PACKING BALES OF COTTON IN RAILROAD CARS

Abstract: *The article under discussion examines the scheme of packing bales of cotton into railroad cars. To maximize the use of carrying capacity and loading capacity of bales we studied the existing norms of their loading into railway carriages with carrying capacity of 62 tons and body volume of 120 m^3. In addition, for shipment of bales of cotton products we offered containers with carrying capacity of 3-5 tons in which bales are stacked according to the optimal schemes that we established.*

Key words: *fiber, railroad, bale, pressure, wagon, moisture, loading capacity, cotton, raw cotton, clogging, optimal, storage, transportation, loop, down, hooch, cushion uluk, hemp, kenaf.*

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Introduction

The storage and transportation of dense fiber bales is much safer in terms of fire safety than loose fiber. Compressed fiber is less contaminated and clogged than loose fiber, and possible losses during storage and transportation are minimized [14, p.213].

It should be mentioned that the mechanization of all the works connected with transportation of bales, their stacking and loading into wagons or cars is much easier if the bales are of regular shape and a certain weight. All of the above clearly confirms the great economic importance of fiber cotton baling.

Calculations show that as a result of the undeniable advantages of cotton bale pressing, although this process requires considerable expenditures of money and packaging materials (tare cloth, wire or steel belt), it is certainly economically profitable.

Main part

There are two basic fundamentally different methods of pressing cotton fiber: compression path pressing in a prismatic box and pressing by winding the fiber canvas in a limited cylindrical volume.

At present, the first method, prismatic bale pressing, is the only one used in the cotton cleaning industry. As for the second method, it has not yet received a rational constructive solution and therefore has no practical application.

The main indicator of degree of compaction of fiber is its volume weight, often called density of pressing and is usually expressed in kg/m^3. The volumetric weight of fiber γ depends primarily on the specific pressure in (kg/cm^2) on the fiber. In order to be able to select by calculation the main parameters of the press, it is necessary to know this basic dependence γ =f L.

For cotton fiber, down, cushion uluk, as well as for hemp, kenaf, bast (flax), the relationship between pressing density and the specific pressure on the fiber is expressed in general terms of control:

$$\gamma = A \cdot \rho^{\alpha}, \qquad (1)$$

where A and α are constant values for the material.

For cotton fiber, the index of degree α can be taken without much error equal to 0.33, in which case equation (1) will take the form:

$$\gamma = A\sqrt[3]{\rho} \qquad (2)$$

The values of constant A, as studies have shown, for cotton fiber do not depend much on fiber properties, which are characterized by a cotton variety, and are 180.2.

A single formula can be accepted for cotton fiber of all selections and industrial varieties (with the exception of the lowest varieties) at 6.2% moisture content:

$$\gamma = 180{,}2\sqrt[3]{\rho} \qquad (3)$$

It should be kept in mind that this empirical formula is valid for the values of $\rho \leq 200$ кг/см^2, at which the research was conducted.

The influence of moisture content for the first grades of cotton fiber is accounted for by the following empirical formula derived by CNIIChProm:

$$\gamma = \frac{6800}{44-\omega}\sqrt[3]{\rho}, \qquad (4)$$

where ω is the moisture content of cotton fiber, (in%).

For belts used annealed steel wire diameter of 4 or 4.5 mm or steel band cross section of 0.7 x 20 mm or 1.0 x 15 mm. When tying wire belts on one end of the wire in advance prepare a loop through which the other end of the belt. Wire belts prepare loops through which to slip the other end of the belt. Wire belts are made on an automatic machine of domestic design. Strapping the bale with steel straps is made with buckles. One end of the band is pre-threaded in the buckle and wrapped to a length of 150-200 mm. The other end is inserted in the same way while strapping the bale. The use of steel tape makes tying the bale easier and faster. At the same time the bales have somewhat smaller humps than with wire belts. In order to avoid the contamination of fibres and prevent losses, bales are packed in tare cloth. For this purpose, a cotton cloth is used [1, p.5].

For mixed rail shipments, bales must be covered on all sides with tar cloth. For rail shipments only the bales may be partially covered with tarpaulin. Tare fabric for bale wrapping is specially cut to ensure economical use of the fabric. The most widely used hemp and jute fabrics are Art. 1029 in width of 106 cm, Art. 1030 in width of 155 cm, and the semi-carded fabric Art. 1031, 75 cm wide.

The woven fabric is cut according to the size of the bale into individual pieces: shawl, which is laid on top in the gap between the upper traverse of the press and the upper edge of the press chamber at the moment of turning the boxes of the press [2, p.8].

For belts used annealed steel wire diameter of 4 or 4.5 mm or steel band cross section of 0.7 x 20 mm or 1.0 x 15 mm.

When tying wire belts on one end of the wire in advance prepare a loop through which the other end of the belt. Wire belts prepare loops through which to slip the other end of the belt. Wire belts are made on an automatic machine of domestic design. Strapping the bale with steel straps is made with buckles. One end of the band is pre-threaded in the buckle and wrapped to a length of 150-200 mm. The other end is inserted in the same way while strapping the bale.

The use of steel tape makes tying the bale easier and faster. At the same time the bales have somewhat smaller humps than with wire belts.

In order to avoid the contamination of fibres and prevent losses, bales are packed in tare cloth. For this purpose, a cotton cloth is used. For mixed rail shipments, bales must be covered on all sides with tar cloth [4, p.42].

For rail shipments only the bales may be partially covered with tarpaulin. Tare fabric for bale wrapping is specially cut to ensure economical use of the fabric [11, p.46].

The most widely used hemp and jute fabrics are Art. 1029 in width of 106 cm, Art. 1030 in width of 155 cm, and the semi-carded fabric Art. Art. 1031, 75 cm wide.

The woven fabric is cut according to the size of the bale into individual pieces:

1) a shawl, which is laid on top in the gap between the upper traverse of the press and the upper edge of the press chamber at the moment of turning the boxes of the press;

2) a cushion that is placed on the running over plunger plate following the pushing of the finished bale out of the press chamber; this operation is combined with the lowering of the plunger

3) heads, which are applied to the ends of the finished bale pushed out of the press and sewn to the shawl and cushion.

Parts of the fabric on the bale are connected by twine (O'zDSt 5725:97) or threads (O'zDSt 3010:97).

In Table 1 the dimensions of cut fabric blanks for bale wrapping are given.

Good packing of bales with cloth prevents loss, contamination and deterioration of cotton fiber and ribbon during their transportation and storage.

Table 1 . Dimensions of bale cloth blanks for bale wrapping

Fabric blanking	**Number of workpieces that make up a kit per 1 bale**	**Dimensions in m**		
		length	width	area in м^2
From hemp-jute-kenaf fabric				
Shawl	1	1,81	1,15	2,081
Pillow	1	0,96	0,68	0,653
Heads	2	0,86	0,65	0,563x2= 1,126
Made of half-cardel fabric				
Shawl	1	1,81	1,125	2,036
Pillow	1	0,96	0,75	0,72
Heads (of hemp and burlap cloth...)	2	0,86	0,65	0,563x2= 1,126

Depending on press capacity and the weight of bales produced by the press, the number of strapping belts is set O'zDSt 3052:97 and varies for presses from 3000 to 5000 kN from 9 to 12 belts.

The reliability of the accepted number of strapping belts is checked using the following approximate formula:

$$K=\frac{P}{2\gamma},$$

where P is the total force on all belts in kn, determined by the graph;

γ-permissible load on the belt in N;

The coefficient allowing for the load distribution between the two belt ends.

The value of γ is determined by the formula :

$$\gamma=fR,$$

where f is the cross-sectional area of the wire or strip in mm^2

R– allowable stress in n /mm^2 (is taken as 200-250 n/mm^2)

Loading bales into rail cars.

In the cotton industry to adopt standards for the size of bales providing full use of the volume of wagons. It should be noted that the approximate stacking scheme of 183 bales at the wagon volume utilization factor of 0,918 developed by CNIIChProm for a 50 t railway wagon. Fig.3 shows the stacking diagram of 200 bales produced by a 550 t press. Bale size is 620 x 620x1000 mm, the volume utilization factor of the wagon is 0,895.

Gaps between adjacent taken in the range 19-28 m, and it is recommended between the side edges and between the ends to take at least 12 mm and between the hump not less than 20.

These schemes are not the only possible. Some plants (e.g., Tashlak) use bale stacking according to their schemes and achieve good results.

The coefficient of volume utilization of the car in the schemes of CNIIChProm reaches the following values as in Table 2.

Table 2. The coefficient of volume utilization of the car

Lifting force of the car (in t)	η_0	Number of bales
16,2—18	0, 909	79
20	0,910	92
50	0,918	183

When stacking bales weighing 250 kg (550 tons of press) - in Table 3.

$$\eta_0 = 0{,}895$$

The following are the accepted norms for loading wagons (in tons).

Table 3.

Power presses (in tons)	Lifting power of cars (in tons)			
	16,5	18	20	50
550	16,5	18,0	20,0	50,0
301–400	16,0	16,0	18,0	37,0
261–300	14,5	14,5	17,0	33,0

Knowing the value of the volume utilization coefficient η_0, you can determine η_0 −coefficient of wagon lifting power from the following ratio:

$$\eta_0 = \frac{\eta_0 V \gamma}{1000Q}, \qquad (5)$$

where useful volume of the wagon, m^2 ;

γ - density of the pressed bale, kg/m^3;

Q - lifting force of the wagon, tons.

For bales produced by 550 t press, the value of η_0 is equal to 1 for all types of cars, including 50 t. To ensure this, the density of the press in this press is assumed to be 650 kg/m^3 (at η_0=0.895).

Thus, at a pressing density of 650 kg/m^3 and bringing the volume coefficient of railway cars to 0,90-0,92 fully solves the problem of using the lifting power of cars.

Conclusions

1. Pressed cotton fiber is packed in bales according to O'zDSt 3152:97 with appropriate dimensions and weights depending on the capacity of the press, grade and type of fiber.

2. Bales of cotton fiber shall be packed on all sides in a textile cloth container protecting the fiber from contamination and loss during storage.

3. As a packaging material is recommended to use:

- Tar nonwoven fabric (O'zDSt 727:97).
- Cotton tissue packing cloth (O'zDSt 17-154:97).
- long-jute-kenaf fabric (O'zDSt 5530:97).

4. Used packaging fabrics are also acceptable, but sturdy and clean, free of oil stains and former markings.

5. Dimensions of normal standard bales should be the following, mm: length-970, width-595, height-735.

In separate cotton-cleaning factories for pressing lint and fibrous waste, low-power presses are used, in this case a deviation from the above dimensions is allowed.

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